8913

Manual of Instructions

Magnetreater®

Model 889B

Radio Frequency
LABORATORIES, INC.
Boonton, New Jersey, U.S.A.

Designers and Manufacturers of Electronic Equipment since 1922

Manual of Instructions

Model 889B Magnetreater®

Designers and Manufacturers of Electronic Equipment since 1922

Radio Frequency
LABORATORIES, INC.
Boonton, New Jersey, U. S. A.

Book No. MA-19600A

Table of Contents

List of Sections

DESCRIPTION

Purpose 3

Function 3

Mechanical 4

OPERATION

Unpacking 4

Preliminary Setup 4

Treating Coils 5

Some Applications 6

MAINTENANCE

High Voltage Precautions 9

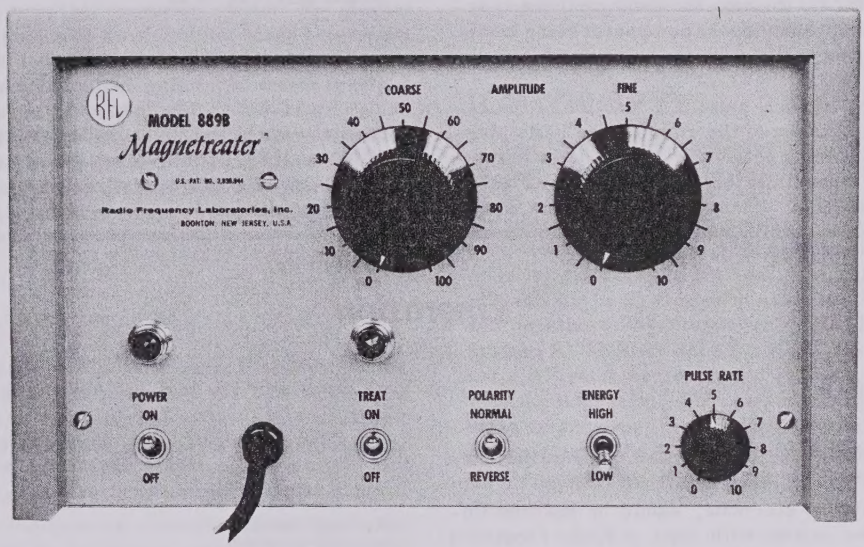
List of Tables

Trouble Shooting Chart 9

Voltage Table 11

Table of Electrical Parts 12

Description



Front panel of Model 889B.

PURPOSE

The Model 889B Magnetreater® is a pulse type of demagnetizer capable of supplying high energy, precisely controlled, for the stabilization of permanent magnets and magnetic assemblies. It is especially useful for the magnetic stabilization of direct current indicating instruments requiring a controlled resolution of better than 0.1%. The Model 889B can be used as the calibration adjusting medium for accelerometers, DC permanent magnet field motors, torque motors or almost any assembly incorporating permanent magnets. In certain cases, the Model 889B can be used for the total demagnetization of permanent magnets.

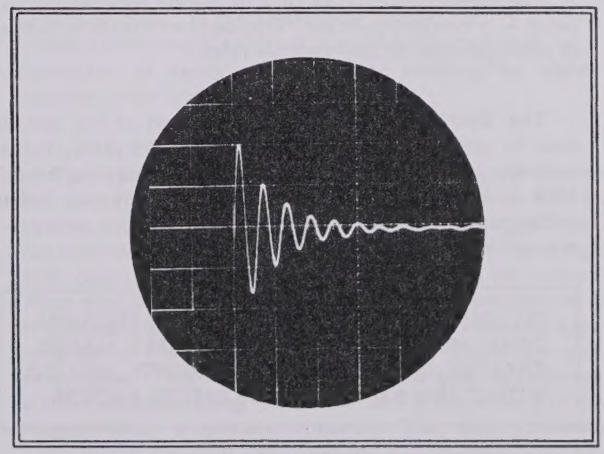
Designed for continuous use on the production line or in the research laboratory, the Magnetreater can be used as an independent entity or in conjunction with a gaussmeter and/or magnet charger as a component of a complete, charging-measuring-stabilization system. Pre-wired receptacles and provision for plug-in relays enable it to be programmed for either automatic or semi-automatic operation.

FUNCTION

Treating or stabilization is accomplished by introducing a series of damped oscillatory pulses into a treating coil. The magnetic assembly to be stabilized is placed in the coil. No mechanical motion of the coil or assembly is necessary; the damped characteristic of the treating pulse gradually reduces the magnetic flux density of the magnet assembly to the desired quantity. The level or degree of demagnetization is controlled by the operator; no particular skill is required.

The switches and controls mounted on the front panel are: POWER ON-OFF, TREAT ON-OFF, POLARITY NORMAL-REVERSE, ENERGY HIGH-LOW, PULSE RATE, COARSE and FINE AMPLITUDE.

The treating action is accomplished by a series of repetitive, decaying pulses. An internal multivibrator in the Model 889B automatically triggers a mercury pool discharge relay at a rate of 60 to 100 pulses per minute, adjusted by setting the PULSE RATE control. Amplitude of the demagnetizing pulse is controlled by the COARSE and FINE controls and can be adjusted to an extremely precise value. The magnitude of power output is continuously adjustable from zero to approximately 50,000



Oscillograph of output.

volt-amperes. This high energy output is produced by discharging, in 50 milliseconds for each pulse, the total energy stored over a one second period. The energy stored in the capacitor bank is discharged into the treating coil which has sufficient "Q" to enable ringing to take place. Polarity of the initial half cycle can be changed by operating the POLARITY switch located on the panel. Since the pulse wave decays to zero, the demagnetizing is accomplished without removing the component being treated from the treating coil.

The frequency of each pulse is a function of the capacitance and inductance of the circuit. The basic Magnetreater employs 100 microfarads in its energy storage bank; additional capacitors (booster units) can be added but are seldom required. When using the available, standard types of treating coils, the pulse frequency ranges from 100 c/s to approximately 200 c/s. This frequency span is generally suitable for all of the stabilizing operations encountered in normal use.

MECHANICAL

The Model 889B Magnetreater is housed in a two-tone grey cabinet measuring 14 inches wide by 8-3/4 inches high by 11-3/4 inches deep and weighs 40 pounds. Unless otherwise specified, it is supplied for operation on 115-volt 50/60 cps lines. A built-in accessory transformer can be furnished for 230-volt operation. Average current demand is 3 amperes.

Operation

UNPACKING

The Model 889B is carefully packed to ensure that normally rough treatment in transit will not damage it. Any damage, concealed or otherwise, should be reported immediately to the carrier with copy to Radio Frequency Laboratories. In the event of damage, all cartons and packing materials should be retained until investigation of the damages by the carrier or its insurance agent is completed.

Standard and special treating coils are packed with the Model 889B. Special treating fixtures which are too large to fit in this shipping container are shipped separately.

PRELIMINARY SETUP

The Model 889B dissipates large amounts of power under prolonged operation. Openings in the cover and chassis provide adequate ventilation, provided that at least three inches of air space are available back of the unit and the under surface is not blocked.

The Magnetreater is designed to operate with its control panel in a vertical position. Tipping it will result in faulty or mis-operation of the mercury relay.

The BOOSTER receptacle on the rear of the chassis must be covered by an insulated, protective plate, unless a booster bank is connected. In no case should the Model 889B be operated with this receptacle uncovered; lethal voltages can exist across its terminals. Also, do not operate unit with cover removed.

DO NOT USE HOMEMADE TREATING FIXTURES; COILS MUST BE DESIGNED TO MEET MAGNETREATER IMPEDANCE REQUIREMENTS AND TO WITHSTAND 600 VOLTS PLUS SAFETY FACTOR.

Place POWER and TREAT switches OFF, POLARITY switch to NORMAL, ENERGY switch to LOW, COARSE and FINE AMPLITUDE controls to 0. Connect treating coil or fixture to the receptacle at the end of the short cord which extends from the front panel.

A. Step-by-step

1. Plug power cord into line and throw POWER switch ON. The red indicator lamp should glow; allow at least one minute for warm-up.

2. Place the TREAT switch ON. The amber glow-lamp should flash at approximately one pulse per second. An audible pulse should be heard from the internal relay, which operates in conjunction with the glow lamp.

3. The unit is now set to treat or stabilize a permanent magnet which has previously been charged to saturation. The magnet assembly is placed inside the treating coil and, in the case of an indicating meter, it should be electrically energized to its final required value which will deflect its pointer beyond full scale. The COARSE and FINE amplitude controls on the Model 889B are advanced until the meter pointer comes to full scale. It is advisable to make some trial runs to get the "feel" of the amplitude controls. The FINE control has about one-tenth of the adjustment that is attainable with the COARSE control.

4. By using a Hall effect gaussmeter with its probe placed in the magnet gap, treating can be accomplished while simultaneously observing the flux density. When the desired operating point of the magnetic assembly is reached, treating can be instantaneously stopped by either returning the COARSE AMPLITUDE control to zero or placing the TREAT switch to OFF. It is usually advisable to reduce the COARSE control to zero to ensure that no residual is retained in the capacitor bank. Where a magnet of high coercive force is being treated or where the magnet assembly is large, it may be necessary to place the ENERGY switch to HIGH position.

B. Using the PULSE RATE control.

The PULSE RATE control varies the time between pulse series. When the magnet being treated is small, a faster pulse rate (higher rate control number) will generally result in somewhat smoother operation. Where the magnet is large, a lower rate may be desirable, since this allows a greater build-up of energy between pulses and consequently a higher discharge pulse for a given setting of the AMPLITUDE controls. A setting of 5 on the PULSE RATE control is generally the average setting, but the best setting for the component being treated is determined by trial. The control rate may vary slightly from line voltage variations, internal temperature changes in the Magnetreater and from age.

C. Using the POLARITY switch.

The initial pulse of each wave series is always greater in amplitude by approximately 15% than the subsequent pulse. Therefore, if the magnet to be treated is placed in the treating coil in a given direction, the initial half-cycle pulse may not be effective, because it may be in the direction of aiding the magnetic induction in the magnet rather than in the opposing direction. Correct polarity can be determined by treating a magnet at a setting of about 10 on the COARSE AMPLITUDE dial, letting the Magnetreater pulse while observing the flux density, then placing the POLARITY switch in the opposite polarity. If no change in flux level is evident then the initial POLARITY switch setting was correct. If, however, a decidedly lower level of flux density is noticed when the POLARITY switch is changed, the second position is the correct one. In many cases, treatment is of such minor magnitude that the polarity is of no consequence, and no attention need be paid to the POLARITY switch. Where the Model 889B Magnetreater is used in a system, the special operational procedure supplied for that system should be followed.

D. Line regulation requirements.

The Model 889B does not employ power line stabilizers. Therefore, the demagnetizing force available in the treating coil will vary slightly as the line emf varies. A line that is very unstable or that has transient pulses of large magnitude can cause seemingly erratic operation of the Magnetreater. For example; assume that a magnet is being treated which requires the COARSE AMPLITUDE control to be brought to a setting of 30. This would apply a charging emf of approximately 250 volts to the energy storage capacitors. If the line should vary 10% during the build up time, a variation of ten to twenty per cent could be expected in the charging level. If a series of magnets were being treated, this could cause a wide range of settings to be used and result in confusion to the operator. The power line should be of reasonable stability or a regulator can be used.

E. Overtreating.

If the amplitude controls are advanced too rapidly, overtreating or over-demagnetization can result. In other words, the magnet can be demagnetized below the desired flux level. Overtreating can also be caused by line voltage variations. Fast pulse rates are usually advisable, since any minor variations in line voltage or operator control will tend to be smoothed out, and the possibility of overtreating will be minimized.

F. Anti-Bias Operation.

The Model 889B Magnetreater has a certain amount of DC bias injected into the treating pulse; the pulses "ride" on the DC bias. This is caused by application of DC charging voltage to the energy storage capacitors simultaneously with the treating pulse. This is of no importance with the majority of treating operations. It is important where small magnets are being treated to near zero flux level. The bias can be removed by plugging relay HA-19611 into the socket marked ANTI-BIAS RELAY. When this relay is added, resistor R7 must be readjusted to limit current through the mercury pool relay. The correct setting of the slider when using the accessory relay is approximately one-third of the distance from the lower end of the resistor. Operation of the Magnetreater remains the same whether the relay is added or not.

TREATING COILS

The Standard Coil Dimension Table shows the inside dimensions of the most widely used standard coils. Many other sizes are available for individual or special applications. Universal fixtures for some types of panel meters are given in the current price list.

The volume or dynamic level of treating flux available depends primarily on the cross sectional area encompassed by the treating coil. Thus, a smaller "window" area will provide a higher treating flux density than will a coil with a larger area, applied energy for both coils being the same. The Model 889B is designed primarily for stabilizing magnets of the steel family; Alnico, cobalt and tungsten. It will, however, treat small volumes of the higher coercive force variety of magnets, such as cobalt platinum and barium ferrite. In the latter case, a coil having a small internal diameter is required to provide the degree of concentration of energy necessary for treating the higher coercive force material.

The type of treating coil required will depend also on the overall configuration of the structure which will be treated. It should be remembered that a rectangular coil has least overall uniformity of demagnetizing field; a high flux concentration will tend to build up in the corners. When treating a large number of magnets in production, it is advisable to fabricate a jig to enable placement of each magnets in the same physical location within the coil every time. This is to ensure that each magnet will receive similar demagnetizing force with one given setting of the Magnetreater amplitude controls. The demagnetizing force in any coil will vary depending on location with respect to center of the coil.

STANDARD COIL DIMENSIONS

PART NO.	RECTANGULAR (INSIDE)	ROUND (INSIDE)
HC-7010-1	$2\frac{1}{2}$" x $4\frac{1}{2}$"	
HC-7010-2	3" x 6"	
HC-7010-3	4" x 8"	
HC-7010-16		$3\frac{1}{2}$" diam.
HC-7010-22		$1\frac{1}{2}$" diam.

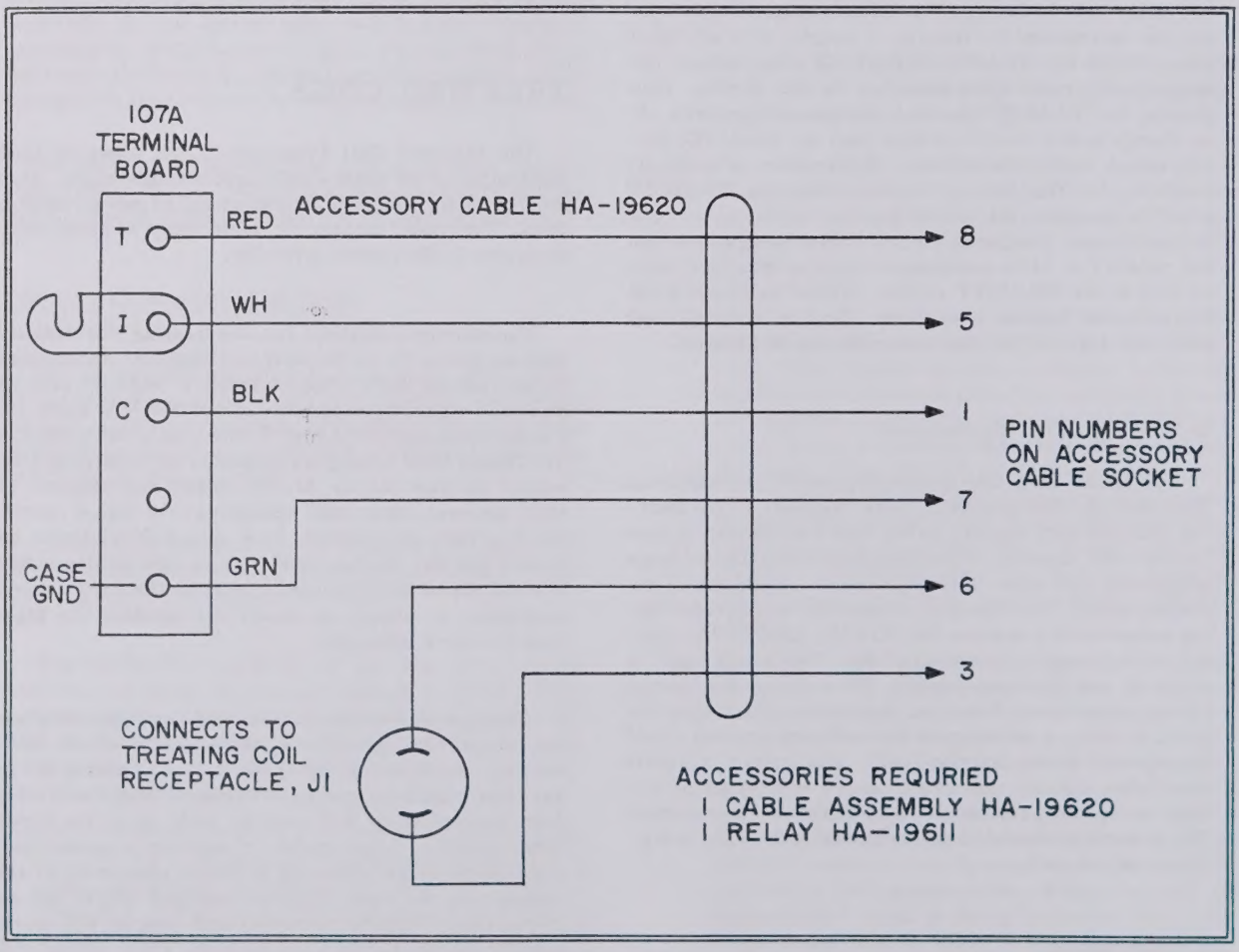
SOME APPLICATIONS

In some cases it may be desirable to treat a U-shaped magnet in the same direction in which it was magnetized. This can be accomplished using the Model 107A Magnet Charger in conjunction with the Model 889B Magnetreater.

The Model 107A is connected to the 889B by means of cable HA-19620. The Magnetreater TREAT switch is placed in the OFF position while the magnet is being saturated by the Magnet Charger. The Charger is then switched off; the TREAT switch is placed ON, and the AMPLITUDE controls are advanced until the desired level of flux density is reached. In this technique, the treating pulses are applied to the charging transformer in the Model 107A Magnet Charger. The drawing below shows how the interconnection is made.

A. System Operation and Programming.

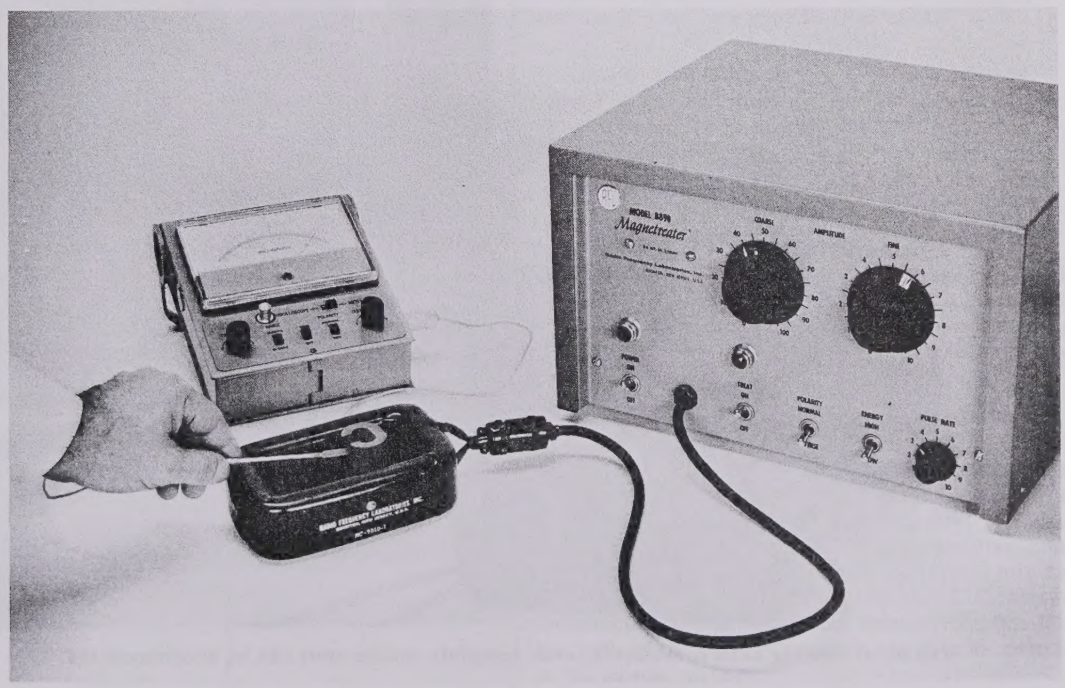
The Model 889B can be operated with any of the RFL Models 107A, 1500, 2470 or 942 Magnet Chargers and/or with the Models 525, 1890 or 1965 Gaussmeters. A socket is provided to allow insertion of a control relay plus an additional programming receptacle on the rear of the Magnetreater chassis to allow interconnection of system components without circuit rewiring. A system composed of the Model 889B Magnetreater, Model 2470 Magnet Charger and Model 1890 Gaussmeter is shown. This system allows the magnet to be charged to saturation, measured, then stabilized to the required flux density with simultaneous measurement without removing the magnet from the combination charging/treating fixture.



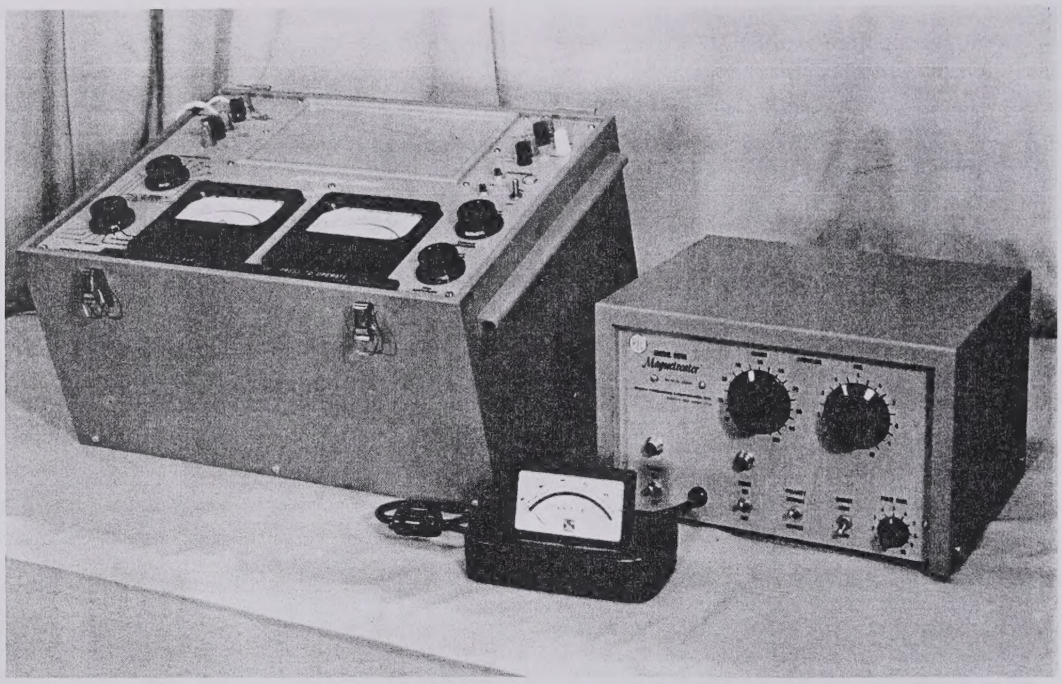
Arrangement for charging/treating through front end of Model 107A.

Charging/treating/measuring system using standard models.

Where magnets are purchased in a charged state or the magnetizing process is done at another location, the Model 889B can be used with a gaussmeter to stabilize to exact levels. The Hall effect Model 525 Gaussmeter shown below will indicate the flux level constantly during the treating operation. As the AMPLITUDE controls are advanced, the gaussmeter will show the decreasing field between the magnet poles; when the flux reaches the desired value treatment is stopped. In some cases, a completely automatic system of stabilizing may be desirable; this can be achieved by using sensing relays in conjunction with a gaussmeter. The overall arrangement operates on a servo system basis with the COARSE AMPLITUDE control motor driven.



Setup for simultaneous treating and measuring flux density.



Model 33 Meter Calibrator supplies current to panel meter being treated.

Completely assembled electrical indicating instruments, which have previously been magnetized to saturation, can be magnetically treated and adjusted using the Model 889B and a calibrated source of current or voltage. The instrument is placed in a suitable coil; the required current or voltage is applied from the calibrator and treating is commenced by operating the Model 889B. When full scale indication is reached, the treating operation is discontinued, and the meter is then ready for any further electrical tests, such as scale distribution calibration.

RFL offers application and design service to any customer involved in the magnetization, stabilization or measurement of permanent magnets or systems. Most of this service is rendered without charge.

Variety of treating coils is available; even complete multimeters can be accommodated.

Maintenance

HIGH VOLTAGE PRECAUTIONS

The line plug should always be disconnected from the power line before attempting to service the Model 889B. Both AMPLITUDE controls should be reduced to zero and the TREAT switch left ON for several seconds to allow discharge of the energy storage capacitors. The unit has a bleeder resistor which discharges fully energized capacitors in about 30 seconds. However, the most diligent precautions must be observed when uncovering the chassis for servicing.

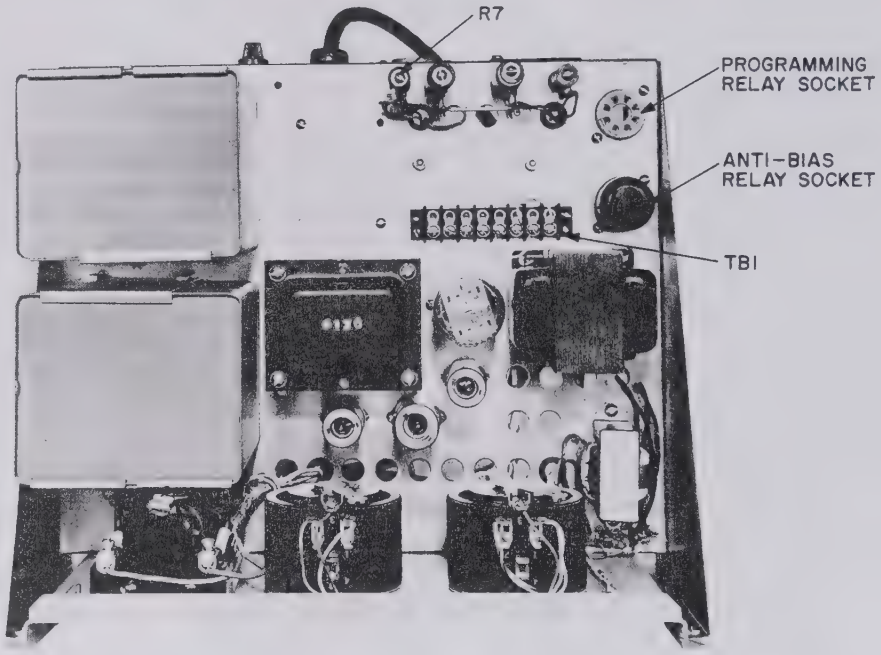
The bottom plate can be removed by upending the unit and removing the eight Phillips head screws which hold the plate in place. The energy storage capacitors should then be discharged by placing a 10,000-ohm, 25 to 50-watt resistor across the capacitor terminals. This resistor should be attached to the end of a bakelite or other insulated rod about one foot long. No servicing should be attempted without first fully discharging the capacitors. The same procedure applies to any booster capacitors which may be plugged into the Model 889B.

Components on the top side of the chassis can be reached by removing the wrap-around dust cover. This cover may be removed by unscrewing the four slotted, round-head screws (two on each side) and lifting the cover off.

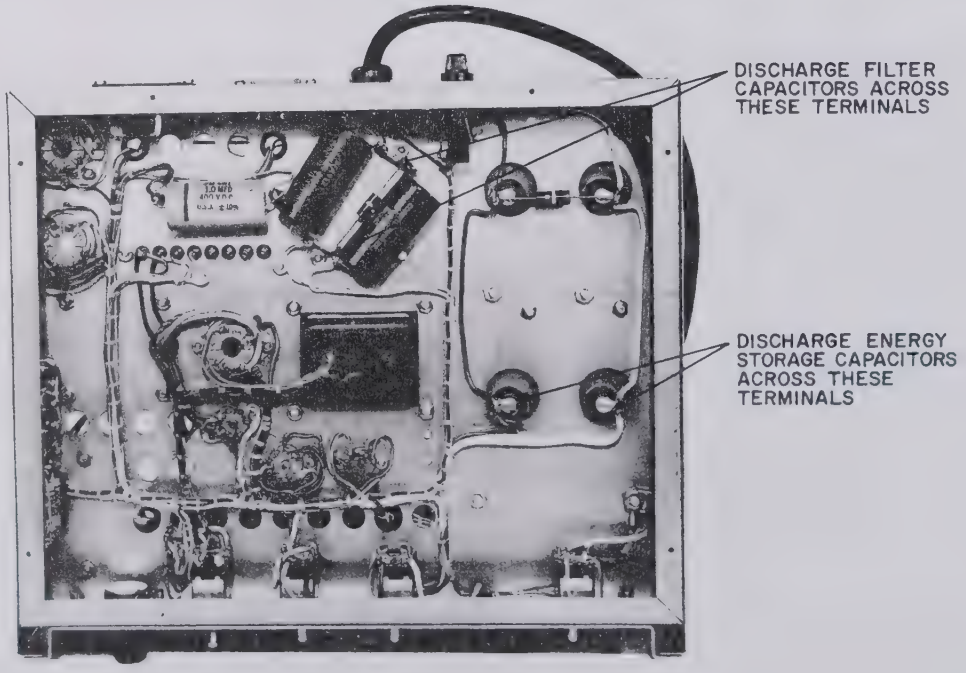
If voltage measurements are to be performed, operate the unit with the AMPLITUDE controls at zero or, if necessary, at a setting no greater than 20 on the COARSE control.

Trouble Shooting Chart

SYMPTOM	CAUSE	REMEDY
Equipment inoperative; power line indicator fails to glow.	Blown fuse. Improper strapping of jumpers on TB-1.	Check and replace if necessary.
No pulse when TREAT switch is placed ON; glow lamp fails to flash.	Defective DC supply circuit. Defect in multivibrator circuit.	Check rectifier 6X4 (V1), multivibrator tube 12AX7 (V2) and keying tube 6AQ5 (V3). Measure voltages associated with these circuits (see voltage table).
Glow lamp flashes but mercury relay, K1 fails to pull down sufficiently to establish contact.	Misadjustment of current limiting resistor R7.	Adjust resistor until mercury relay pulls down properly. Observe high voltage precautions.
Glow lamp flashes with intense brilliance and mercury relay pulls down with excessive force tending to splash mercury.	Misadjustment of R7.	This effect will generally not be apparent when the anti-bias relay is not used, since the current applied to the relay is limited by the emf drop in keying tube V3. R7 should be adjusted until relay operates in correct manner. Observe high voltage precautions when adjusting R7.
Intermittent treating operation.	Mercury pool low in relay K1.	This may be caused by mercury coalescing on the walls of the relay tube and thereby effectively lowering the level of the pool. Prolonged use with subsequent raising of internal temperature of the equipment can cause this condition. Remove power cord from line; turn 889B over and rest it upside down for several minutes. Then return it to its operating position. This allows the mercury pool to "wash" the mercury droplets from the walls of the tube. Operation can then be continued in the normal manner.



Top view of Model 889B chassis.



Bootom view of Model 889B chassis.

Voltage Table

All voltages measured with multimeter having sensitivity of 20,000 ohms/volt DC and 5000 ohms/volt AC.

TUBE	PIN NO.	VOLTAGE	REMARKS
V4 - 5U4GB	2	640 DC	Amplitude controls all the way to the right. Voltages measured with common lead of test meter connected to the negative terminal of the energy storage capacitors. Energy switch in HIGH position. Treat switch in ON position.
	4	450 AC	
	6	450 AC	
	8	640 DC	
V1 - 6X4	1	280 AC	Amplitude controls all the way to the left. Voltages measured with common lead of test meter connected to negative terminals of filter capacitors C1 and C2.
	6	280 AC	
	7	360 DC	
V2 - 12AX7	1	150 DC	
	2	0 to -8 volts pulsed DC.	
	6	300 to 350 volts pulsed DC.	
	7	-10 to -75 volts pulsed DC.	
V3 - 6AQ5	5 & 6	0 to -0.25 volt pulsed DC.	
	7	-10 to -50 volts pulsed DC.	

Table of Electrical Parts

*Recommended Spare Parts for Overseas Use

DIAGRAM SYMBOL	DESCRIPTION	FUNCTION	RFL PART NO.
C1, C2	CAPACITOR, fixed electrolytic: 30 μF, 450 v.	Filter capacitor.	H-1007-85
C3, C4	CAPACITOR, molded mylar: .01 μF, 400 v.	Wave shaping capacitor.	HA-12972
C5	CAPACITOR, molded mylar: 1 μF, 400 v.	Frequency determining capacitor.	H-1007-101
C6	CAPACITOR, molded paper: .05 μF, 400 v.	Frequency determining capacitor.	H-1007-59
C7, C8	CAPACITOR, oil filled, paper: 50 μF, 600 v.	Energy storage capacitor bank.	HA-1609
F1	FUSE: 2A, 250 v, 3AG, slo-blo.	Protective fuse.	HA-1289 (*1)
I1	LAMP, indicator: 6-8 v.	On-Off indicator.	HA-1045 (*1)
I2	LAMP, neon glow. NE-51 neon	Pulse indicator.	HA-2468
K1	RELAY, mercury.	Discharge relay.	HA-12910 (*1)
P2	PLUG, jumper.	Blocks programming circuit.	HA-19622
R1	RESISTOR, fixed: 820 ohms, 1 w, ±10%.	Filter resistor.	H-1009-601
R2, R3	RESISTOR, fixed: 100 K, 1 w, 10%.	Wave shaping resistor.	H-1009-426
R4	RESISTOR, fixed: 390 K, ½ w, 5%.	Frequency determining resistor.	H-1009-427
R5	RESISTOR, fixed: 560 K, ½ w, 10%.	Frequency determining resistor.	H-1009-716
R6	RESISTOR, variable: 500 K, 2 w, 10%.	Pulse rate control.	HA-10751
R7	RESISTOR, adjustable: 3500 ohms, 10%.	Pulsing relay current control resistor.	H-1100-216
R8	RESISTOR, fixed: wire-wound, 15 K, 10 w, 10%.	Programming relay current limiting resistor.	H-1100-401
R9, R10	RESISTOR, fixed: wire-wound, 15 ohms, 25 w, 5%.	Current limiting resistor.	H-1100-195
R11	RESISTOR, fixed: 560 K, 2 w, 10%.	Safety discharge resistor.	H-1009-719
R12	RESISTOR, fixed: 1 meg, 1 w, 10%.	Safety discharge resistor.	H-1009-146
S1	SWITCH, toggle, d. p. s. t.	Power ON-OFF switch.	HA-7037
S2, S3, S4	SWITCH, toggle, d. p. d. t.	Energy High-Low, Treat On-Off, Polarity Normal-Reverse.	HA-7036 (*1)

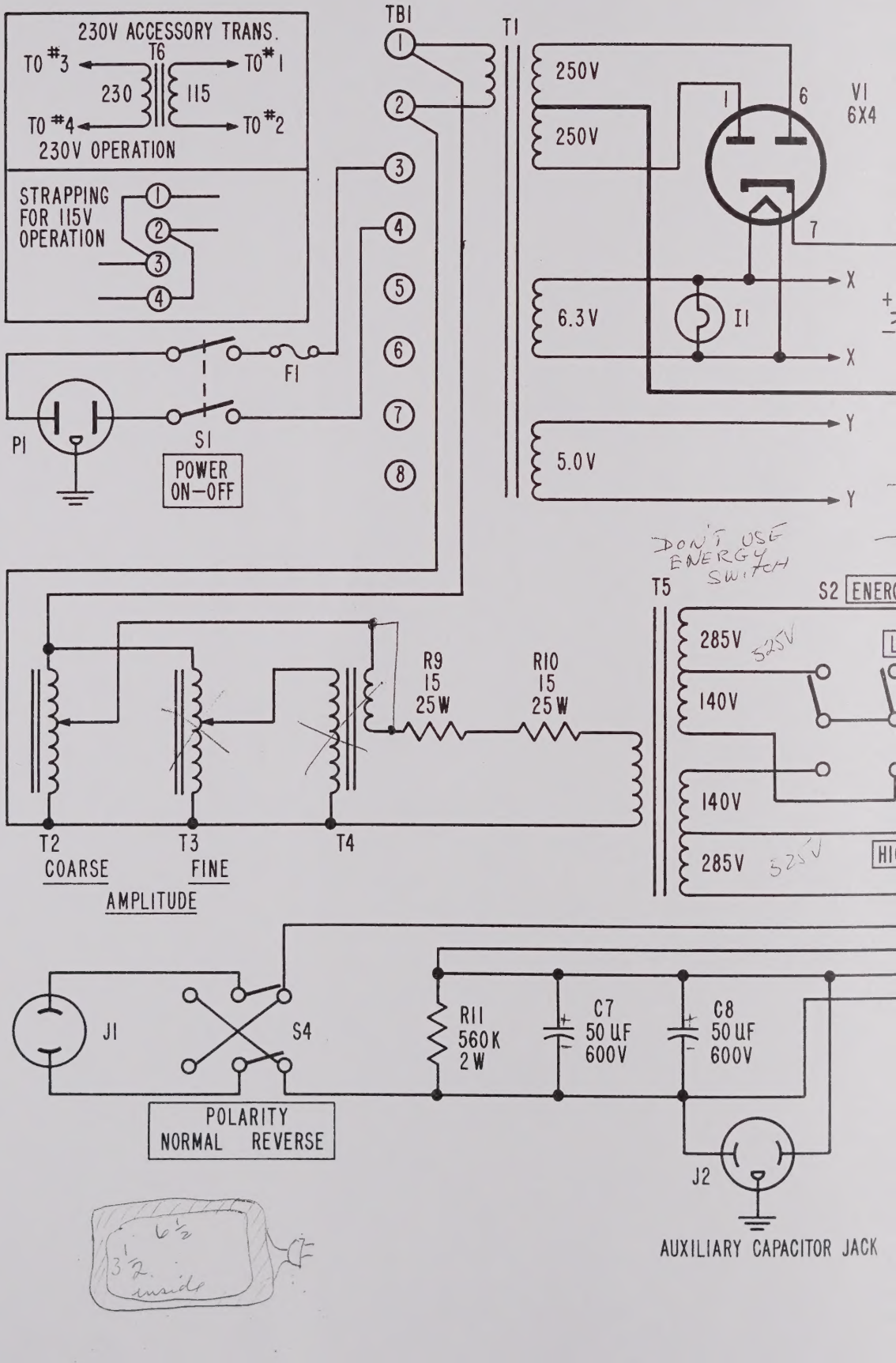
Table of Electrical Parts

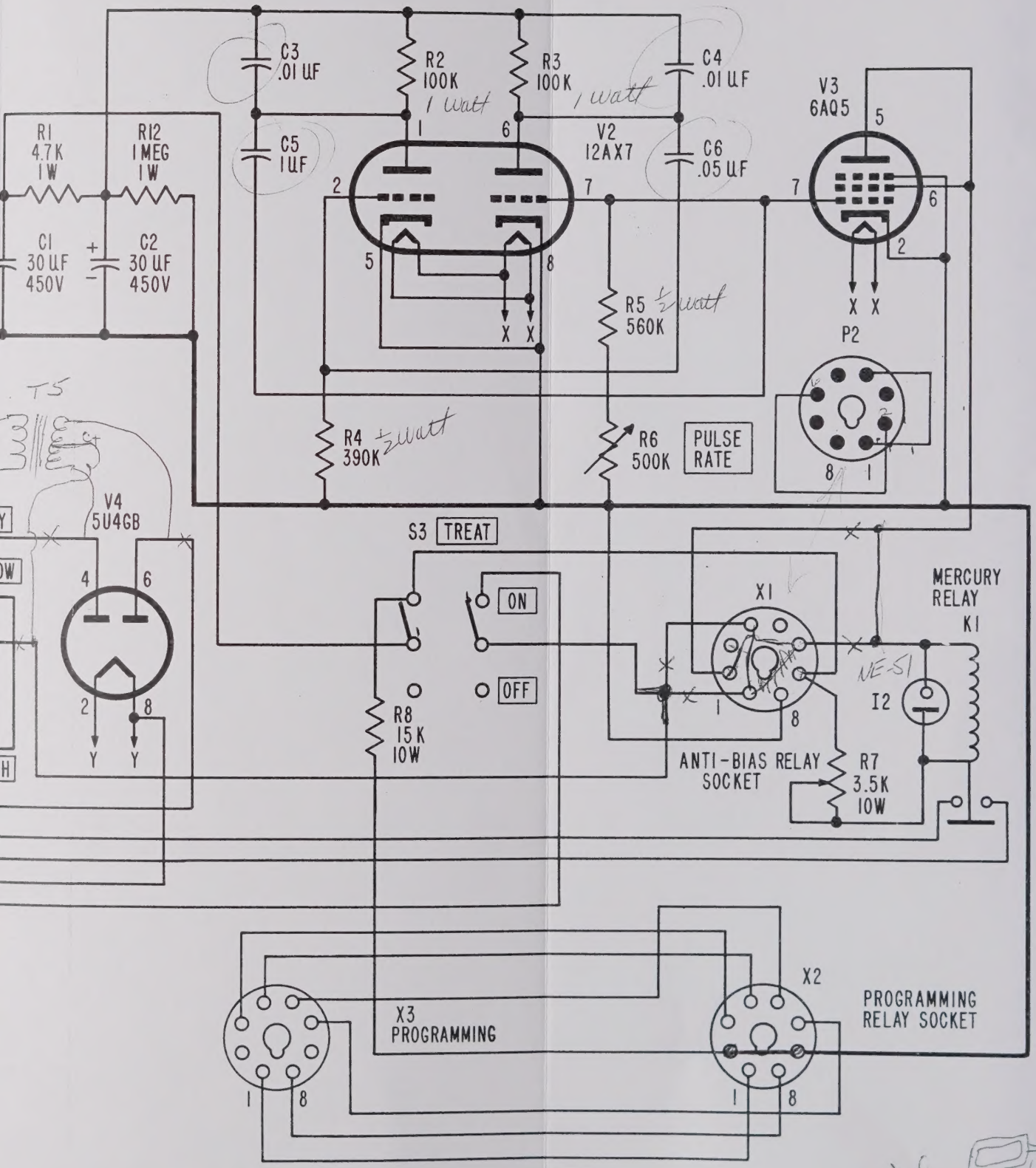
*Recommended Spare Parts for Overseas Use

DIAGRAM SYMBOL	DESCRIPTION	FUNCTION	RFL PART NO.
T1	TRANSFORMER, power. Stancor PC-8403	Filament and B plus power.	HA-7016
T2, T3	TRANSFORMER, variable.	Coarse and Fine energy amplitude transformers.	HB-18165
T4	TRANSFORMER, 117 v to 6.3 v.	Fine amplitude ratio transformer.	HA-8782
T5	TRANSFORMER, power. Stancor plate xformer PC-8302	Energy storage power transformer.	HA-6136
T6	TRANSFORMER, line (used for 230-volt line operation only).	230 v to 115 volt step down transformer.	HA-2114
V1	TUBE, electron, type 6X4.	B plus rectifier.	HA-3672 (*1)
V2	TUBE, electron, type 12AX7.	Multivibrator.	HA-2287
V3	TUBE, electron, type 6AQ5.	Keying tube.	HA-3565
V4	TUBE, electron, type 5U4GB.	Energy storage rectifier.	HA-6172

MERCOID RELAY
W-2C-3
120 V 60~ 30 AMPS

JENSEN INSTRUMENTS
[illegible] BEVER y BW


230V ACCESSORY TRANS.
T6
TO #3
TO #1
230
115
TO #4
TO #2
230V OPERATION
STRAPPING FOR 115V OPERATION
TBI
T1
250V
250V
6.3V
5.0V
V1
6X4
F1
P1
S1
POWER ON-OFF
DON'T USE ENERGY SWITCH
T5
S2
285V
140V
140V
285V
R9
15
25W
R10
15
25W
T2
COARSE
T3
FINE
T4
AMPLITUDE
J1
S4
POLARITY
NORMAL REVERSE
R11
560K
2W
C7
50 uF
600V
C8
50 uF
600V
J2
AUXILIARY CAPACITOR JACK
6½
3½
inside



Schematic Diagram Model 889B Magnetreater®

Coil
900 turns
#16